Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Spectrum Policy Task Force Seeks Public	)	ET Docket No. 02-135
Comment on Issues Related to Commission's	)	
Spectrum Policies	)	

COMMENTS OF TEXAS INSTRUMENTS

Texas Instruments Incorporated ("TI") submits these comments in response to the Commission's Public Notice; FCC 02-322 released November 25, 2002, seeking comment on the Spectrum Policy Task Force Report.

Summary of Position

The Spectrum Policy Task Force notion of a spectrum "commons" can be applied not only to Local Area Networks (LANs) but to Wide Area Networks (WANs) as well. Technical and interoperability standards for unlicensed WANs can be developed by industry standards bodies, subject to FCC regulatory oversight. A commonly-accessible control channel network would be needed to control access to communications channels, because "listen before talk" access protocols are not effective for wireless networks deployed over wide areas. Rapid deployment of unlicensed WANs relies on participation by incumbent cell phone and PCS operators, because their existing tower and backhaul infrastructure would be valuable in operating the unlicensed services. While there are some technical and regulatory challenges in implementing unlicensed WANs, they are not insurmountable.

TI's Interest

Texas Instruments Incorporated is the world leader in digital signal processing and analog technologies, the semiconductor engines of the Internet age. The company's businesses also include materials and controls, and educational and productivity solutions. TI is headquartered in Dallas, Texas and has manufacturing or sales operations in more than 25 countries.

For more than six decades, TI has created innovations in mobile communication, including the first commercial silicon transistors in 1954, the first integrated circuit, and the first electronic handheld calculator. Silicon increased the performance while lowering operating temperatures, enabling the miniaturization of electronics —a major step forward for mobile communications. Over the years, TI developed even higher-performance and lower-power semiconductors and worked with its customers to develop smaller and lighter-weight wireless phones, the first and second generations of wireless technology. TI chips today process billions of instructions per second providing the power behind all points in telecommunications—from wireless handsets and Internet devices to networks.

TI’s programmable DSP technology is key to maximizing companies’ investments in a state of evolving technology. Programmability allows manufacturers to reuse valuable engineering design from previous generations to build multiple product lines, enabling backward and forward compatibility for smooth transitions as standards evolve. This results in shorter time-to-market and lower development costs.

TI’s technology provides benefits to all areas of wireless communications, from the handset manufacturer to the telecommunications service provider.

Handsets and Handhelds

TI has established itself as a market leader in wireless semiconductors shipped in handsets today. Further establishing TI as the leader for 2.5 and 3G, the top wireless

handset and handheld manufacturers across the world have already have chosen TI's technology for their future devices. Similarly, multiple operating system vendors have worked with TI to port their software platforms on TI's processors.

TI provides complete "antenna-to-applications" chipset solutions, including families of digital baseband modems, analog and power management integrated circuits, RF processing and powerful application processors. To enhance system flexibility, TI also includes a complete range of peripheral support including USB, Bluetooth™, removable flash cards, camera controllers, stereo codecs, drivers and other capabilities. Importantly, in addition to these silicon and software building blocks, TI provides complete wireless reference designs that enable designers to rapidly develop and deliver new products.

TI also offers its widely adopted OMAP™ platform that includes high-performance, power-efficient processors, robust, easy-to-use OMAP software and technical support. With TI's OMAP platform, equipment manufacturers and software developers can quickly get to market with differentiated voice and multimedia applications for 2.5G and 3G wireless phones, PDAs and advanced mobile Internet appliances.

Cellular Infrastructure

Wireless service providers have invested heavily in developing the marketplace and in purchasing bandwidth to deliver their services across the next-generation wireless infrastructure. Now, wireless infrastructure companies are looking to companies like TI to help them quickly deploy as many channels of next-generation, media-rich wireless connectivity as possible. Channel density translates into the ability to service more customers, which provides a higher return on investment for infrastructure providers as well as service providers. TI's DSP technology increases channel density by providing the highest performance DSP tailored for 3G wireless infrastructure applications. Also important for base station manufacturers, TI's solutions offer flexibility to support all industry standards.

Wireless Networking – 802.11

As home and office networking continues to gain momentum, wireless LAN technology will become increasingly significant. With IEEE 802.11b (also known as Wi-Fi) and Bluetooth, consumers can easily, without wires, connect multiple PCs, peripherals and other Internet appliances to rich content including voice, data and video information. Outside the home and office, consumers are also finding that they can stay connected to their personal business by using PCs with wireless modem cards, that work with the wireless networks now found in many hotels, airports and coffee shops across the country and internationally.

As a leader in both Wi-Fi and Bluetooth, TI is well positioned to drive silicon and software trends toward longer reaches and higher data rates, while maintaining the highest levels of performance. TI utilizes Bluetooth technology for creating personal area networks and other short distance wireless applications, while leveraging its Wi-Fi solutions for wireless local area networking. Committed to enabling the price points required for widespread adoption of wireless networking technology, TI delivers highly integrated, high performance solutions with its Bluetooth and 802.11 chipsets.

TI Proposal - Unlicensed Wide Area Networks

These comments focus on the concept of a cellular Wide Area Network (WAN) system operating on unlicensed spectrum, consistent with the use of non-exclusive "commons" spectrum in the Commission's Spectrum Policy Task Force report. Our concept differs from the more traditional use of unlicensed spectrum for low-power, short-distance devices, because the power levels and ranges will be higher. While the traditional approach was constrained by limited device capabilities to avoid or mitigate interference, we believe that future smart technologies will overcome these constraints.

The comments are divided into the following sections:

- A quick look at today's 802.11 technology;
- Discussion of the benefits of an unlicensed WAN;
- FCC interoperability rules as enablers;
- Network architecture;
- Regulation and standardization;
- Next steps; and
- Summary

A Quick Look at 802.11 Technology

Unquestionably, there is exploding market demand for Local Area Network (LAN) devices that conform to the IEEE 802.11 standards. Consumers and companies can buy and install these private networks for a one-time cost. In addition, service providers have begun installing 802.11 LAN "hot spots" at commercial and public locations (coffee shops, airports, etc.) where they sell access to the Internet, employing a variety of pricing plans.

One advantage to 802.11 is that is operates on *unlicensed spectrum*. No entity is required to make an investment in spectrum by paying auction prices for spectrum. In addition, there are no FCC-imposed exclusivity requirements that restrict who can enter the market and what services are provided. While equipment vendors may have a large upfront cost to enter the device manufacturing business, the cost of operating an 802.11 "hot spot" is relatively low. The major item of infrastructure is a base station access point, which today sells for $150 or less.

The 802.11 technology has been widely adopted despite lack of nationwide coverage. This shows that there is marketplace demand for services that are not yet ubiquitous.

Short-range technology based on the 802.11 standards is not well suited for Wide Area Network (WAN) services. Typical devices have a range of about 100 meters. In order to cover a metropolitan (or larger) area, and particularly in order to serve mobile users,

many access points would be needed, and many backhaul links would be needed to interconnect the access points. In addition, 802.11 LAN technology provides no support for mobility. The concept of handoff as the user moves out of range of the initial access point is simply not part of the LAN standards. Consequently, while 802.11 LANs provide excellent support for Internet access within limited coverage areas, they are not a substitute for WANs.

Benefits of Unlicensed WANs

Clearly, unlicensed spectrum has the advantage that there is no cost or regulatory burden to obtain use of spectrum.[1] A WAN-based on unlicensed spectrum will result in a rich mix of services available to the public, with differing quality-of-service levels and differing prices. For unlicensed spectrum, the Commission would retain exclusive control over spectral efficiency, and could impose technology migration plans if market forces do not provide sufficient incentive.[2]

Unlicensed WANs, implementing the technical concepts described in these comments, can be deployed first as small networks and expanded to cover larger areas. The system is designed to use present day cellular towers for lowest rollout cost. Support for peer-to-peer calling, perhaps using higher power levels to achieve longer ranges, can benefit users in rural areas where few network operators have installed towers and base stations.

Finally, we note that unlicensed WANs will also provide many of the other benefits of the "commons" model outlined in the Spectrum Policy Task Force report.

[1] While we use the term "unlicensed spectrum" in these comments, we recognize that FCC-issued licenses may be necessary for enforcement of RF exposure regulations or other legal requirements. We mean that such licenses should not provide the assurance of interference protection that go along with most current licenses for cellular and PCS service. Consequently, while we use the term "unlicensed spectrum" it may have to be interpreted as "non-exclusive spectrum."

FCC Interoperability Rules will enable useful Unlicensed WANs

Unlike the CSMA/CA protocol used in 802.11 and 802.16, the long range, high mobility nature of WANs requires a different control structure. The key technical element of our proposed unlicensed WAN is the control channel network, which is used to assign communication channels and avoid interference.[3] Control channel networks will employ wired, wireless and a combination of wired / wireless channels. Fixed access points and base stations would be connected together using wired channels, and handsets would interact with bases stations and with other handsets over wireless control channels.

The control channel network regulates access to all unlicensed spectrum as a function of frequency, time and location. Handsets (and base stations) continually know their location. They monitor both the spectrum and control channels, looking for available service (spectrum, time slots, codes, etc.). Once available spectrum capacity is identified, the handset and base station broadcast an intention to use it over the control channels. The broadcast message conveys the technical parameters of the session, including what spectrum will be used in which location and for how long.

The control channel network will include a clearinghouse function that includes a map of spectrum availability. The clearinghouse database, for example, could be accessed over the Internet. We believe such a spectrum clearinghouse capability is technically feasible today. This mechanism enables the user's access to available spectrum.

From an economist's point of view, if spectrum is available "for free" then a scheme is needed to assure fair access to it. One approach could employ a priority metric that assigns higher priorities to handsets that have the lowest levels of recent usage. In addition, the priority system would have to assign the highest priorities to emergency 911 calls and support location-based services.

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[2] Based on experience with 802.11b and 802.11g at 2.45 GHz, the need for additional Government regulation in the area of spectral efficiency seems unlikely.

Regarding spectrum usage, the Commission may want to establish rules to prohibit wasteful or inappropriate use of system resources. For example, all unlicensed WAN handsets could also be required to incorporate a short-range capability such as Bluetooth or 802.11 or UWB. They would be expected to use the short-range technology before accessing the WAN technology. The Commission's equipment authorization program is suitable for enforcing such rules.

We believe that the tradeoff of good spectral efficiency for handset power consumption can be achieved with optimal modulations and efficient protocols. Because of interoperability needs, an industry standards body would develop an agreement on the modulations and protocols that might be employed, subject to the Commission's general oversight.

Coverage of rural areas is enhanced using peer-to-peer (P2P) communications. P2P (handset-to-handset) calls can be completed only when handsets are within range of one another. Otherwise, base stations would be used. However, in remote areas, longer-range peer-to-peer (or handset-to-base station) transmissions might be allowed if consistent with RF safety needs. P2P sessions will not support handoffs since they will not have access to the infrastructure needed for handoffs. Peer-to-peer calls between handsets in motion can be supported under some circumstances. In addition, we believe that many handsets will comply with the existing worldwide mobile standards to allow international roaming.

[3] A "listen before talk" protocol is not efficient over the multi-kilometer distances needed for WANs.

Cell Phone and PCS Operators Are Essential Participants

An unlicensed WAN service requires network infrastructure that is much like the network infrastructure of existing cell phone and PCS operators. A control network is needed to provide access to communications channels, and to support handoffs for mobile handsets. Databases are needed to determine whether a handset is active, and where it is located. Towers are needed so that the signals can propagate over a wide area. Backhaul links are needed to interconnect towers and connect to other networks.

We expect that the most rapid deployment of unlicensed services will rely on much of the infrastructure of existing cell phone and PCS operators. Thus, while there will be no regulatory barriers to new entrants, incumbent operators will have an incentive to participate because of this advantage. In fact, because of their existing plant investment, we believe that participation of those incumbent operators is essential to the success of unlicensed WANs.

We also envision a service model that is a hybrid of licensed and unlicensed service. When the unlicensed spectrum is congested, calls can overflow to higher quality-of-service licensed spectrum and vice-versa. Operators can offer different service tiers, at different quality levels, and subscribers can choose which tier they want.

Regulation and Standardization Requirements

We believe that some level of FCC regulation and/or industry standardization is needed for an unlicensed WAN service to develop.

Interoperability specifications such as channel bandwidths and modulations are needed. Interference specifications will be developed as in-channel and out-of-channel power limits are needed. A standardized protocol is needed for the control network, and a user priority scheme must be established to assure fair access.

A regulatory approach must be developed to post the temporary availability of spectrum that may be exclusively licensed but is available for temporary periods. This would enable incumbents to offer their spectrum for short term use. The Commission may determine that licensees should post this information to a clearinghouse, if that is a reasonable way to assure its availability through the control channel network.

In any event, the Commission's equipment authorization program can assure that handsets are compatible with the technical and operational requirements of the rules and standards.

Next Development Steps

The development of an unlicensed WAN environment raises a number of significant challenges. Some of these issues should be handled by industry standards bodies and/or trade groups, and others should be explored and defined by the Commission.

The FCC has several choices available for unlicensed WANs, such as shared allocation with other services, or an exclusive allocation for unlicensed WANs. Depending upon the spectrum allocations, it may be necessary to compensate existing licensees that are forced to relocate. If so, taxes or fees might have to be imposed on operator revenues or on handset equipment sales.

Standards bodies would be organized to develop an advanced air interface so that systems can dynamically allocate spectrum. The body would choose one or more modulation methods that work well even when the network is unsynchronized. In addition, an air interface access method and a protocol must be adopted by a standards body.

The Commission may chose to define a control channel network specification that includes both wired and wireless transport. This definition would include database

specifications for both the presence and location of handsets, and the availability of channels and blocks of spectrum. In order to support both channel selection and wireless E911 calling, a location determination technique must be adopted.

Finally, a user priority scheme may be needed to insure fair and balanced sharing of spectrum and assure spectrum access for emergencies.

Summary

Texas Instruments believes that an unlicensed WAN system is feasible. It is based on a control channel network that allows access to dedicated unlicensed spectrum and flexible use of temporarily available spectrum (licensed spectrum temporarily available for unlicensed access). Industry involvement through standards bodies and FCC policy deployment will insure an unlicensed wide area system that would provide significant benefit to the U.S. communications industry and U.S. consumers.

Respectfully submitted,

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